SOCKET WRENCH EXTENSION WITH IMPROVED TORQUE TRANSMISSION

CROSS REFERENCES TO RELATED APPLICATIONS

[001] This is a continuation of U.S. Patent Application No. 10/086,487 filed on February 28, 2002, which in turn is a continuation-in-part application of U.S. Patent Application No. 09/638,699 filed on August 14, 2000, now abandoned, which, in turn, is a continuation-in-part application of U.S. Patent Application No. 09/100,987 filed on June 22, 1998.

BACKGROUND OF THE INVENTION

Field of the Invention

[002] The present invention relates to a socket wrench extension with improved torque transmission.

Description of the Related Art

[003] Fig. 5 of the drawings illustrates a typical extension 50 having a first end engaged with a socket-engaging member of a socket wrench 51 and a second end with a driving column 53 for engaging with a socket 52. A drawback of the extension 50 is that the driving column 53 cannot drive the socket 52 at an angle other than alignment, i.e., the axis of the driving column 53 must coincide with that of the socket 52. Yet, in some cases, it is difficult to operate the socket wrench in such alignment status.

[004] Fig. 6 of the drawings illustrates an improved extension 60 having a first end engaged with a socket wrench 61 and a second end with a driving column 64 for engaging with a socket 62. A recessed section 65 is defined between the driving column 64 and a main body of the extension 60. As a result, the user may conveniently apply force to loosen/tighten a nut (not shown) or the like adjacent to a wall (not shown). However, the torque transmitted to the nut is lowered. Further, the stress will concentrate on the recessed section 65, which lowers the strength of the extension 60. As a result, the extension 60 cannot be used in cases where high torque is required.

[005] U.S. Patent No. 1,924,089 to Croessant issued on January 9, 1932 discloses an extension member for socket wrenches wherein the extension can be disposed in an operating position at an angle to any of a plurality of interchangealbe sockets each having a suitably shaped cavity for engaging nuts or bolt heads of various sizes. Nevertheless, the extension member cannot be used in cases where high torque is required, either.

[006] U.S. Patent No. 4,436,005 to Hanson issued on March 13, 1984 discloses a rotary torque adapter for transferring rotational torque force from a power source such as an electric drill to a socket tool device which transfers torque force to the nut or bolt being tightened or loosened depending upon the rotation direction. Such a rotary torque adapter is only suitable for transferring rotational torque force from a power source to a socket.

[007] There is a long and unfulfilled need in a manual socket wrench extension that may be operated either in an upright manner when high torque is required or in an angular relationship with the socket for driving a nut or bolt head located in a place that is difficult to access.

SUMMARY OF THE INVENTION

[008] It is a primary object of the present invention to provide an improved socket wrench extension that allows angular joint between the socket and the driving column of the extension without adversely affecting the torque transmission.

[009] The present invention provides a combination of a socket and an extension to solve the drawbacks of the prior art. The socket includes a first end having a square hole and a second end adapted to engage with a fastener. The square hole is defined by a plurality of sidewalls. Each sidewall has a concave portion in an intermediate portion thereof.

[0010] The extension comprises a main body having a first end adapted to be releasably engaged with a wrench and a second end spaced from the first end of the main body in an axial direction. A driving column is formed on the second end of the main body for releasable engagement with the square hole of the socket. The driving column includes a recessed section defined in a periphery thereof adjacent to the second end of the main body. The shoulder has a cross sectional size perpendicular to the axial direction that is greater than a cross sectional size of the recessed section perpendicular to the axial direction and smaller than a cross sectional size of the main body perpendicular to the axial direction, the driving column including a receptacle. A ball and an elastic element are received in the receptacle, the ball being biased by the elastic element to partially protrude out of the receptacle.

[0011] The main body, the shoulder, and the driving column including the recessed section are integrally formed as a single component.

[0012] The driving column is engageable with the concave portions of the square hole of the first end of the socket spaced from the main body with a gap being defined between the

recessed section of the driving column and the sidewalls defining the square hole of the socket and with the ball pressing against one of the concave portions of the square hole under action of the elastic element. The concave portions of the square hole of the socket allows the driving column of the extension to move to a desired orientation relative to the socket, thereby allowing angular joint therebetween for operation in a difficult-to-operate condition.

[0013] The shoulder of the driving column being engageable with the sidewalls defining the square hole of the socket in a position other than the concave portions to provide high torque transmission therebetween in which a longitudinal axis of the driving column coincides with that of the socket, wherein the ball is received in the receptacle of the driving column and pressed against one of the sidewalls defining the square hole of the socket in a position other than the concave portions under action of the elastic element.

[0014] Other objects, advantages, and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Fig. 1 is a perspective view of a socket wrench extension in accordance with the present invention, a socket, and a socket wrench.

[0016] Fig. 2 is side view, partly sectioned, of the socket wrench, the extension, and the socket, illustrating engagement between the extension and the socket for a difficult-to-operation condition.

[0017] Fig. 3 is a view similar to Fig. 2, illustrating engagement between the extension and the socket for high torque transmission.

[0018] Fig. 4 is an enlarged view of a portion of Fig. 3

[0019] Fig. 5 is a side view of a conventional socket wrench extension, a socket wrench, and a socket in section.

[0020] Fig. 6 is a side view of another conventional socket wrench extension, a socket wrench, and a socket in section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0021] Referring to Figs. 1 to 4 and initially to Fig. 1, a socket wrench extension in accordance with the present invention generally includes a main body 10 having a first end

releasably engaged with a socket wrench 20 and a second end on which a driving column 14 is integrally formed so as to releasably engage with a socket 30, with the first and second ends being spaced in an axial direction.

[0022] The socket wrench 20 includes a handle 22 and a head 21 extending from the handle 22. A drive member 26 is mounted in the head 21 and includes a drive end 23. The drive end 23 includes a receptacle 27 (Fig. 2) receiving an elastic element 28 and a ball 24. A portion of the ball 24 protrudes out of the receptacle 27 under the action of the elastic element 28.

[0023] The main body 10 of the extension includes a square hole 11 defined by plural inner wall faces 12 each having an engaging groove 13. The square hole 11 can be engaged with the drive end 23 of the socket wrench 20. The driving column 14 of the extension includes a recessed section 15 defined in a periphery thereof adjacent to the second end of the main body 10. In addition, a shoulder 16 is defined between the recessed section 15 and the second end of the main body 10. The shoulder 16 has a cross sectional size perpendicular to the axial direction that is greater than a cross sectional size of the recessed section 15 perpendicular to the axial direction and smaller than a cross sectional size of the main body 10 perpendicular to the axial direction. The drive column 14 further includes a receptacle 18 for receiving an elastic element 19 and a ball 17. A portion of the ball 17 protrudes out of the receptacle 18 under the action of the elastic element 19.

[0024] The socket 30 includes a first end having a square hole 31 and a second end having a hexagonal hole 34 for engaging with a fastener such as a nut or the like. The square hole 31 is defined by a plurality of sidewalls 32 each having a concave portion 33 in an intermediate portion thereof.

[0025] In use, referring to Fig. 2, the drive end 23 of the socket wrench 20 is engaged in the square hole 11 of the extension with the ball 24 of the drive end 23 being engaged in one of the engaging grooves 13. Thus, the wrench is securely engaged to the extension. Next, the driving column 14 of the extension is engaged in the square hole 31 in the first end of the socket 30 with the ball 17 of the driving column 14 pressing against one of the concave portions 33 of the socket 30 under the action of the elastic element 19. As illustrated in Fig. 2, there is a gap between the recessed section 15 of the driving column 14 of the extension and the sidewalls 32 defining the square hole 31. This allows angular joint between the recessed

section 15 of the extension and the socket 30 for operation in a difficult-to-operate condition. Namely, the extension can be moved to a desired orientation while the socket 30 remains still. This is because the concave portions 33 of the square hole 31 allow rotational movement of the driving column 14 of the extension.

[0026] Alternatively, as shown in Figs. 3 and 4, the driving column 14 of the extension may be engaged in the square hole 31 of the socket 30 with the shoulder 16 of the extension engaged with the sidewalls 32 defining the square hole 31 of the socket 30 in a position other than the concave portions 33 to allow high torque transmission in which a longitudinal axis of the driving column 14 coincides with that of the socket 30. It is noted that the ball 17 of the driving column 14 retracts into the receptacle 18 and the elastic element 19 is compressed. Nevertheless, the ball 17 still presses against one of the concave portions 33 of the socket 30 in a position other than the concave portion 33 under the action of the elastic element 19.

[0027] It is noted that the spindle of the extension disclosed in U.S. Patent No. 1,924,089 to Croessant merely allows angular joint with the socket as shown in Fig. 1 thereof. Namely, the extension of Croessant's design cannot be used in an upright manner when high torque is required. The bead or flange adjacent to the neck of Croessant's design is intended to limit the engagement of head with socket opening as described in column 1, line 55 through column 2 lines 1-2 thereof, not for providing upright engagement with the socket.

[0028] Although the extension is described with reference to a socket wrench, it is noted that the extension may be used with other types of wrenches.

[0029] Although the invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.